

Before the  
**FEDERAL COMMUNICATIONS COMMISSION**  
Washington, D.C. 20554

In the Matter of: )  
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Amendment of Part 90 of the Commission's Rules ) WP Docket No. 07-100  
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**COMMENTS OF CAMBIUM NETWORKS LTD**

Cambium Networks Ltd. (Cambium) hereby submits comments in response to the Federal Communications Commission's Fourth Report and Order and Fifth Further Notice of Proposed Rulemaking (FCC 12-61).

Cambium welcomes the Commission's proposed rule change to extend eligibility for use of the 4.9 GHz band to include Critical Infrastructure Industry (CII) entities. We consider that this rule change will promote increased use of the 4.9 GHz band whilst ensuring that deployments in the band remain properly coordinated, and public safety applications continue to be protected from interference.

Cambium notes the Commission's proposal to allow airborne operations under certain restricted circumstances. We urge caution in this matter, and consider that it may be difficult to

coordinate deployment of airborne transmitters so as to protect critical ground-based infrastructure from interference.

Cambium notes the Commission's proposal to restrict fixed point-to-point (PTP) wireless links to horizontal or vertical polarization. Under the proposed rule, dual polarization would not be permitted. We consider that dual polarization of PTP links is a valuable technique in this band, allowing for higher overall capacity within congested areas, and allowing for deployment of non-line-of-sight links with high availability in rural or other less congested areas. We strongly urge the Commission to reconsider this proposed rule change and to allow dual polarized PTP links subject to certain conditions.

Dual polarization can be used together with polarization multiplexing to deliver double the capacity of a single-polarized link within a given channel bandwidth. Frequency coordination of links in a dense network can be achieved more efficiently by deploying dual-polarized links in place of single-polarized links that deliver the same capacity and occupy two adjacent channels of similar bandwidth. The increase in efficiency arises because coordinators must always consider the potential for cross-polar interference from reflected single-polarized transmissions. The use of dual polarization links with cross-polar interference cancellation (XPIC) is a common way to increase the density of links in licensed microwave bands.

Dual polarization can also be used together with polarization diversity to ensure high availability in non-line-of-sight links. The fading characteristics of non-line-of-sight paths often lead to relatively poor availability for single polarization links, likely to be unacceptable in public safety or critical infrastructure applications. Fading is largely uncorrelated in the two polarizations, and polarization diversity generally results in significant improvements in availability. Dual-polarized links may be a practical solution for some links in rural areas where

use of dual polarization over a non-line-of-sight path will avoid the need for an addition repeater station.

Cambium recommends that the Commission should empower frequency coordinators to grant dual polarization licenses for fixed PTP links on a case-by-case basis considering the potential benefits of an overall reduction in interference, or an overall increase in deployed capacity, or a reduction in the number of relay stations relative to deployment of single polarized links.

The Commission asks if the need for interoperability warrants adoption of technical standards in this band. Cambium recognizes that standardization of technology generally has significant benefits for a homogeneous application, whereby equipment cost is reduced because of increased economy of scale, purchasers gain a choice of suppliers, and users can interoperate during joint deployments. However, we consider that these benefits are unlikely to be achieved by the introduction of a standard air interface protocol for use in the 4.9 GHz band. Furthermore, we consider that adoption of a standard is likely to stifle innovation and prevent introduction of new products optimized to meet specific public safety requirements.

Cambium would like to draw the attention of the Commission to the following:

(a) The 4.9 GHz band supports a wide variety of different fixed and nomadic public safety applications and it is unlikely that one standard will be well suited for all of these applications. We note that existing networks that benefit from standardization generally support a single type of application (for example cellular phones).

(b) Fixed PTP links are normally purchased and installed as pairs of units, and there is little benefit to the operator from interoperability. Furthermore, there are no satisfactory standards existing for PTP links.

(c) There are no air interface standards defined for use in the 4.9 GHz band, and no standards-based products are immediately available for use in this band. The Commission would presumably need to oversee the transition to a future standards-based regime. We consider that the transition might last for several years, and during this period operators would most likely be unwilling to install non-standard equipment, meaning that the under-utilization of the band would continue.

(d) The potential cost saving from the use of highly integrated semiconductor devices of the type developed for WiMAX, WiFi or LTE systems is no more than a few \$10's per unit, and this saving is small compared with the overall cost of manufacturing, deploying and operating a station in a public safety system. This saving will not justify use of a standard that is not well suited to applications in the public safety band.

(e) Interoperable wireless standards are associated with industry bodies that define specific interoperability profiles and organize testing and certification. These bodies do not presently have profiles for the 4.9 GHz band. The Commission might be obliged to form a business relationship with an industry body and test house to develop 4.9 GHz profiles and tests. The potential benefits of interoperability are unlikely to be achieved without defining specific profiles with rigorous testing and certification.

(f) One potential benefit of interoperability is for nomadic units to operate away from their home network, for example where user groups are dispatched to a different part of the country to assist in managing an emergency situation. This application requires interoperability

at multiple protocol layers, not just at the physical and medium access control (MAC) layers. To be successful, the visiting user groups must have a compatible approach to many different functional areas in higher layers, including authentication, use of security certificates and revocation lists, authorization, encryption, key distribution, quality of service profiles, gateway addresses and telephone switching. We consider that it will not be practical to deliver full interoperability for multiple forces in a joint deployment without building what amounts to a single country-wide network, or at least putting in place detailed roaming agreements between multiple operators. We note that standards bodies and operators have expended considerable effort to ensure that roaming operates effectively in cellular networks.

(g) The IEEE 802.11 standard is poorly suited to applications in fixed outdoor PTP and PMP networks. Existing PTP and PMP products that make use of integrated semiconductors originally developed for use in IEEE 802.11 products almost always operate with a MAC layer specifically modified for outdoor operation. These products no longer comply with the IEEE 802.11 standard. Each manufacturer takes a different approach and their products are not in any way interoperable.

(h) Time division duplex (TDD) networks require synchronization to operate effectively where multiple links are collocated. TDD synchronization is not supported by IEEE 802.11.

Cambium strongly recommends the Commission to maintain the existing spectrum mask for high-power transmitters in the 4.9 GHz band. A relaxation of this spectrum mask is likely to adversely affect frequency coordination and may make existing high-performing systems unuseable.

Cambium notes that the Commission has suggested extending eligibility to commercial users of the 4.9 GHz band on a secondary basis. We understand that this change would increase

the utilization of the band, but we have serious concerns regarding the practicality of the mechanism by which commercial users will shut down when required by use of primary systems in the band. This might make the band less attractive to public safety users, particularly in tactical deployments where there is little time to detect and trace commercial users that have failed to shut down. We cannot recommend use of the band by secondary commercial users unless an extremely robust sharing mechanism can be put in place. If public safety users cannot rely on uninterrupted access to the band, it may be that overall use of the band will decrease rather than increase.

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